far towards solving many of our chief difficulties. It is perhaps somewhat revolutionary, but, whether we like it or not, even the scientific times move forward, and we can no longer maintain—most of us cannot afford to maintain—our pre-war usages. One would like opinions on this matter, for action of some kind will need to be taken in the not distant future.

WILLIAM B. BRIERLEY.

Rothamsted Experimental Station,
Harpenden, August 29.

Whispering-Gallery Phenomena at St. Paul's Cathedral.

THE very curious and interesting acoustical effects observed in the Whispering Gallery under the dome of St. Paul's Cathedral have, as is well known, been explained by the late Lord Rayleigh as due to the curvilinear propagation of sound, the waves which proceed from a source placed close to the wall of the gallery clinging to its surface and creeping tangentially along it. This view was developed mathematically by Lord Rayleigh ("Scientific Papers," vol. 5, p. 617), the theoretical conclusions arrived at being (*a*) that the sound-waves travel in a comparatively narrow belt skirting the wall, the thickness of this belt decreasing with the wave-length of the sound; (*b*) that in this belt the intensity is a maximum near the wall and decreases rapidly and continuously as we proceed radially away from it; and (*c*) that the intensity does not fluctuate markedly as we proceed circumferentially parallel to the wall.

We were much interested in the subject, and by the courtesy of the authorities of the cathedral have been enabled to carry out an extended series of observations in the gallery with the view of making a precise test of Lord Rayleigh's theory. Our experiments show conclusively that while the indication of theory as expressed in (*a*) is substantially accurate, neither of the conclusions (*b*) and (*c*) is in accordance with actual facts. Using a steady source of sound placed close to the wall at one point, we found that elsewhere the intensity of the sound showed pronounced oscillations in proceeding inwards radially from the wall, the ear of the observer passing several times through alternate zones of great intensity and of comparative silence. In the latter some of the overtones of the source could be heard clearly, while the fundamental was practically inaudible. These alternations of intensity could be demonstrated in the gallery, using a fairly high-pitched source and a sensitive flame as indicator. The distance between the successive zones of silence was about the same as the half-wave-length of the source. There were also distinct periodic fluctuations of intensity in proceeding circumferentially—that is, parallel to the wall. The latter were not equally distinct in all parts of the gallery, being most marked at the other end of the diameter containing the source.

The circumferential fluctuations of intensity might be interpreted as being, at least in part, due to the stationary interferences of waves which meet after passing in opposite directions round the gallery. But the radial fluctuations are less easily explained, and must be regarded as fundamental in any satisfactory theory of the Whispering Gallery. We find that effects similar to those we observed at St. Paul's may be demonstrated in the laboratory with any large circular reflecting surface, using a bird-call with a sensitive flame as sound-detector.

The experiments thus show that, while the explanation put forward by Lord Rayleigh is at least on the right lines, it is far from being a completely satisfactory theory of the Whispering Gallery. We propose at an early opportunity to go more fully elsewhere into the question of the revision necessary in the theory.

C. V. RAMAN.
G. A. SUTHERLAND.

22 Oxford Road, Putney, S.W.15, August 26.

Ceratium furca and Pedalion mirum.

IN describing the specific characteristics of *Ceratium furca*, one of the Peridiniæ or Dinoflagellates, Saville Kent in his "Manual of the Infusoria" gives the habitat as salt-water, and he appends a note to the effect that, "although usually regarded as entirely marine, M. Werneck has reported the occurrence of an apparently identical species in fresh-water in the vicinity of Salzburg."

It may be of interest to students of the Protozoa to state that on August 19 and 27 I discovered this species in two separate bodies of fresh-water in this district. It may be the case that other workers have found the form at other points in Great Britain, and that, by reason of my not having access to the scattered literature on Protozoa, I am only reporting an already well-established fact; but it will be most interesting to know whether *Ceratium furca* has been found elsewhere in this country, and I shall be glad to have the views of those who have given attention to this matter.

Kent gives the entire length of *C. furca* as 1/120th of an inch, say 212 microns. I find that very few of my specimens are so small as this, and I have measured several up to 256 microns, which is 21 per cent. larger than the recorded length.

The remarkable and interesting Rotifer, *Pedalion mirum*, discovered by Dr. Hudson in 1871 is described in Hudson and Gosse's classical work, "The Rotifera," as being very rare, and up to the date of the publication of that work, twelve years later, it had been recorded only from three places. Others have doubtless since been added, but Pedalion may probably still be regarded as a rare species. I have found it in both the waters in which *Ceratium furca* occurred, and in the first gathering on August 19 it was fairly numerous. A list of the known habitats of this Rotifer would be most interesting.

ALFRED E. HARRIS.

44 Partridge Road, Roath, Cardiff, August 29.

Illumination of Plankton.

IN avoiding compressed-air illness by the excellent method which we owe to Dr. J. S. Haldane, divers ascending from deep water often have to spend periods of half an hour or so in idleness suspended on a rope in mid-water 20–30 ft. below the surface. The blank tedium of such occasions can be relieved by watching the ebb and flow of plankton past the face-glass of the helmet and musing on the remarkable variation in its apparent quality and quantity from day to day.

As the diver looks upwards and inwards towards the black, shadowy keel of the salvage vessel he sees the individuals of the plankton standing out vividly by a sort of dark-ground illumination. Turning his head outwards and looking into unrelieved water space, again using a simile from microscopy, the field is overflooded with light, contrast is absent, and the teeming multitudes blend into granular haziness. In August, after our salvage ship has been moored for an hour or two in the open sea, mackerel find her out, and daily a compact shoal of them con-

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gregates some 20–40 ft. below, remaining in position until she gets under way and quits the spot.

A diver hanging in the shoal has a clear space some 6 ft. wide around him; beyond this the water is crammed with mackerel, the outline of the shoal corresponding roughly with that of the ship above. One sees that the fish are feeding on plankton, not by steadily pumping the water through their gill-filters, but snatching gulps from different directions, turning their eyes about and making little jumps here and there. Evidently the depth they maintain, slightly different from day to day, is that at which their food is drifting; but what is the mysterious attraction that keeps roving fish fixed beneath a stationary ship for hours together?

A paper by Bullen in the Journal of the Marine Biological Association for June, 1912, produces evidence (from examination of stomach contents and aquarium observations) that mackerel when feeding on plankton exercise selective powers, picking out certain forms, such as Copepods, and rejecting others, presumably by visual means. After observing the shoals on many occasions while hanging suspended in their midst, I feel sure that it is the assistance given by the black background of the ship to visual selection that links the fish to her.

Most objects floating in the open seas, jellyfish, sharks, driftwood, or derelicts, when carefully approached, are found to be accompanied by fish satellites. The attractive force is not necessarily the same in every case, but where (as in the case of the mackerel under the salvage ship) the stomach contents turn out to be selected plankton it is probably a matter of illumination.

It is likely that each member of a shoal is benefited by the background afforded by the bodies of its immediate neighbours, and, if so, a factor in the shoaling habit comes to light. Going deeper, a use suggests itself for the lateral light-producing organs of some bathypelagic fishes which are so placed that they can scarcely assist the fishes' own vision.

G. C. C. DAMANT.

H.M. Salvage Vessel *Racer*, Lough Swilly.

Co-operative Indexing of Periodical Literature.

I AM much interested in the leading article in NATURE of June 9 entitled "Co-operative Indexing of Periodical Literature," because the H. W. Wilson Company is doing on a commercial basis what the publications you mention are doing on what you call a "co-operative basis." This leads to an inquiry as to when the publication of an index or abstract is "co-operative." Perhaps co-operation meant originally the donation of indexing work on the part of individuals or libraries. However, it appears that of the co-operative publications mentioned none of the editorial work is donated. The "Engineering Index" is now published by one of the great engineering societies, and its deficit paid by that society. The deficit of the "Index Medicus" is met by the Carnegie Institution of Washington. The deficit of the "Index to Legal Periodicals," published by the H. W. Wilson Company, is made good out of the treasury of the Association of Law Libraries, and the deficit of the "Agricultural Index" is made good out of the treasury of the H. W. Wilson Company. In the case of all these publications subscriptions are solicited, and the income is used to pay for editorial work and expenses so far as it will go, the deficits being met as stated. Is the publication of an index less "co-operative" if the deficit is met by an individual or a corporation than if it is met by an association or a foundation? In other words, should not a corporation engaged in an educational work be recognised as "co-operating" with men of science and scholars in the diffusion of knowledge?

Librarians say that indexes are more used in libraries than abstracts and digests. This, of course, does not imply that abstracts and digests are not useful to scientific and professional people, but since the chief support for abstracts, indexes, and digests comes from libraries, should not the advice of librarians be considered? A mere examination of the physical condition of various indexes and abstracts in libraries might be a fair indication of their comparative usefulness, and prove to be a revelation to those who are paying some of the deficits.

At one time the subject of agriculture was considered by the Committee on the International Catalogue of Scientific Literature, and it was expected that a volume covering this subject would some time be published. The publishing of our "Agricultural Index" gives opportunity to compare the value of a dictionary-catalogue published on the "cumulative plan" monthly, annually, and triennially with a classified catalogue published only (and tardily) as an annual. Would it not be interesting to make inquiries among those who use such reference tools most in order to determine what method is most efficient? If it should be found that indexing and cataloguing publications produced by private corporations actually serve a useful purpose, and perhaps relieve "co-operative" organisations of some share of the deficit, should not these publications receive, if not commendation, at least a nod of recognition?

I have wondered why men of science, when planning catalogues or classifications, do not consult those who make that work a profession. When people build houses it is generally thought best to consult an architect.

It may be worth while to note that of the four examples of indexes that you mention, three are now compiled on the alphabetic or dictionary plan. The "Engineering Index," published since 1884, changed from the classified to the dictionary form on the annuals with the year 1919. The "Index Medicus" has just recently changed from the classified to the alphabetic form. We believe the changes were made at the request of librarians who have, through their experience, found the dictionary plan the more serviceable.

It is to be hoped that in the conference proposed by NATURE, to which representatives of all branches of knowledge are to be invited, librarians and all those who make printed indexes will be included.

H. W. WILSON,
President.

The H. W. Wilson Company, Publishers of
Indexes and Reference Works, 958–964
University Avenue, New York City,
August 6.

A CO-OPERATIVE index is one published by, or on behalf of, a professional body with the view of securing an adequate standard of efficiency. These indexes are generally based, in part at any rate, upon voluntary labour. Mr. Wilson is in error in supposing that the main support for abstracts and digests comes from the libraries. It is derived from the subscriptions of members of the professional bodies. Librarians are not qualified to advise on the matter.

Indexing suffers chiefly from the lack of co-ordination and the insufficient supply of trained workers. It is to secure a proper co-ordination of effort that a conference has been proposed in these columns. The conference should undoubtedly include representatives of the libraries and of the commercial indexes.

THE WRITER OF THE ARTICLE.

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